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MEXICO: HER PHYSICAL GEOGRAPHY AND RESOURCES.

BY

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At the present day no foreign country possesses so large a share of importance to the people of the United States as Mexico. Lying between the fifteenth and thirty-second parallels of north latitude, the Mexican Republic has an area of 756,336 square miles,* or about sixteen times the size of the State of New York.

The northern frontier is defined by the Rio Grande, the Territories of New Mexico and Arizona, and the State of California. The southern boundary is marked by the Republic of Guatemala and the Territory of Balize, or British Honduras; while the Gulf of Mexico and Pacific Ocean respectively bound the east and west coasts.

A continuation of the cordillera of South America traverses the Republic, and has received the local name of the Sierra Madre. The general direction of this chain of mountains is from southeast to northwest. It has a moderate elevation in the southern States of Chiapas and Oaxaca; but, in latitude 19°, the mean altitude is about 9,000 feet above the sea-level, and two peaks, Popocatepetl and Orizaba, respectively rise to the great elevations of 17,720 feet and 17,200 feet. The former mountain is the culminating point of North America.

On the twenty-first parallel the cordillera becomes very wide, and is divided into three ranges. The eastern branch runs to Monclova and Villaldama; the western branch traverses the States of Jalisco and Sinaloa, and subsides in Northern Sonora; while the central ridge extends through the States of Zacatecas, Durango, and Chihuahua, forming the water-shed of the northern table-land. The range decreases in elevation in going northward.

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* 1,958,912 square kilometres.

A row of six volcanic mountains stretches across the cordillera, four of which are clothed with perpetual snow, and form some of the highest land in the western hemisphere.

The names of these volcanoes, beginning on the west, are Colima, Jorullo, Toluca, Popocatepetl, Iztaccihuatl, and Orizaba.

That great traveler and scientist, Baron von Humboldt, has stated in *Cosmos*, Vol. V., page 265, that these volcanoes lie on the same great vent in the earth's crust, between the latitudes of 18° 59′ and 19° 20′, thus indicating the direction of a fissure of volcanic activity of 360 geographical miles in length.

Excepting Jorullo, all of these mountains had been upheaved before the Spanish Conquest.

This new volcano deserves more than a passing notice. It rose on the night of September 28, 1759, from a broad plain having an altitude of 2,580 feet above the sea-level.

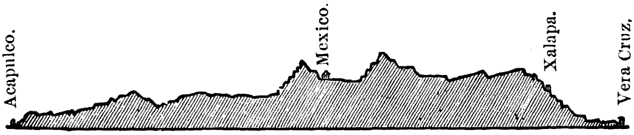
Jorullo lies about eighty miles from the Pacific Ocean, and fully 120 miles from any other volcano. The eruption was preceded for at least three months by an uninterrupted subterranean noise. At the point where the great volcano now stands there was formerly a dense wood of the *guayava.* On the day before the eruption, laborers from the *cañaverales*, or sugar-cane fields of an adjoining *hacienda*, had gone out to gather the fruit of the *guayava.* Upon their return it was remarked with astonishment that their large straw hats were covered with volcanic ashes. Fissures had been formed in the earth's surface, which threw out ashes, before any apparent change of level had occurred in the plain.

In the early hours of the night of September 28 the black ashes already lay a foot deep. Every one fled toward Aguasarco, a small Indian village situated on a neighboring hill, 2,500 feet above the old plain of Jorullo. From this height a large tract of land was seen in a state of fearful, fiery commotion; and in the midst of the terrible flames there appeared a great shapeless mass resembling a black castle.

The accounts of the eye-witnesses state, that on the day of the eruption the flat soil was seen to rise perpendicularly, and the entire mass became more or less inflated, so that colossal blisters appeared, of which the largest is now the volcano. These inflated blisters were of various sizes, and had a tolerably regular conical form. They subsequently burst, and threw boiling hot earthy mud from their orifices, as well as scoriaceous stony masses, which are still found at an immense distance from the volcano. The heat, which characterized the eruption, was so intense that for many years the environs of Jorullo had not cooled to their normal condition. In the year 1780, or twenty-one years after the eruption, cigars might still be lighted, when fastened to a stick and projected to a depth of two or three inches into the *hornitos*, or little ovens, the name given to the conical protuberances of the plain. In some places the air was so much heated near the *hornitos* that travelers found it necessary to turn aside from their proposed course.

Referring to the eruption of the volcano, Humboldt remarks, that the natives ascribe the wonderful change in the earth's surface to the work of the monks. At the Playas de Jorullo, the Indian, whose hut the German traveler occupied, told him that in 1759 the Capuchins belonging to the mission preached at San Pedro, but failed to receive hospitable treatment. Accordingly, they pronounced anathemas upon this beautiful and fertile plain, predicting first of all, that the houses would be destroyed by flames, which would issue from the earth, and that afterward the surrounding air would cool to such a degree that the neighboring mountains would remain eternally covered with snow and ice. The former of these maledictions having been verified, the lower class of Indians already see in the gradual cooling of the volcano the presage of a perpetual winter.

Nearly one-half of the superficial area of Mexico is composed of an elevated plateau having a mean height of about 6,000 feet about the sea-level. This plateau extends from the frontier of the United States almost to the Isthmus of Tehuantepec. It is widest in the latitude of the national capital, being about 350 miles at this point, and contracts gradually toward the south.



Mexican Table-land.

From "Appleton's Guide to Mexico."

The principal table-lands of the northern plateau are, that of Chihuahua, which lies north of latitude 24°, and east of the Conchos and Florida rivers, and having an elevation of of from 4,000 to 6,000 feet, and that of Anahuac, which is from 6,000 to 8,000 feet high. There are four distinct table-lands on the central plateau, as follows:

That of Toluca,	having a mean	elevation of	8,570 feet.
That of Tenochtitlan,	"	"	7,470 feet.
That of Aclopan,	"	"	6,450 feet.
That of Istla,	"	"	3,320 feet.

Two passes, about 500 miles apart, afford an outlet from the great table-land to the eastward—viz., that of Jalapa, through which Cortez build a road during the Conquest; and one at Saltillo, through which the United States troops reached the plateau during the Mexican War.

Referring to the uniform character of the surface of the great plateau, Humboldt has remarked that the traveler may proceed in a four-wheeled carriage on the ridge of the table-land, from the City of Mexico to Santa Fé, a distance of at least 1,200 miles, without the advantage of artificially prepared roads.

The country is divided into three hypsometrical zones, as follows:

The *tierra caliente*, or hot region, extending from the sea-level to an elevation of about 2,500 feet; the *tierra templada*, or temperate region, ranging from 2,500 to 5,000 feet; and the *tierra fria*, or cold region, which lies above 5,000 feet.

The first-named zone borders the Republic on the east for about seventy miles, and on the west for about fifty miles.

It has the usual high temperature characteristic of equatorial latitudes. Here sandy plains are intermingled with morass and dense jungle in which tower up trees of that luxuriant growth which is found only within the tropics. The attention of the traveler is kept constantly on the *qui* *vive*, by the brilliant plumage of the birds, the beautifully variegated hues of the insects, and the gorgeous colors and grateful fragrance of the flowers that belong to this realm of eternal summer. Among the flora of this zone may be mentioned the vanilla, sarsaparilla, indigo, cassava, aniseseed, various fruits, and the flowering cocoa-palm.

In the *tierra templada*, the aspect of nature essentially changes. The atmosphere is frequently moist, as here the cool air descends from the great plateau and meets the heated atmosphere which ascends from the hot zone. The sugar-cane and the banana, the large leaves of which oftentimes shade the coffee plant, are common, as well as many kinds of vegetables. Camphor and bamboo trees also grow in abundance.

In the *tierra fria*, the change of fauna, flora, and climate has become so strongly marked, that the traveler may easily imagine himself in a high northern latitude. The rosewood, mahogany, ebony, and Brazil-wood of the low country are replaced by the oak, willow, poplar, elm, ash, pine, and other coniferous trees. The traveler will also see the magnificent primeval forests of the cypress, with graceful festoons of the so-called Spanish moss, hanging from the branches, and swinging to and fro in the gentle breeze like the loosened ropes of a ship. Indian corn, although grown in the other great natural terraces, thrives on the table-land. The same remark will apply to the *maguey*, or aloe, which is extensively cultivated. The cereals, especially wheat and barley, are also raised. On the northern plateau the varieties of the cactus family are plentiful. Among them are the *organo*, resembling the pipes of an organ, the curious *pitahaya* with its gorgeous flowers, the giant cactus rising occasionally to a height of forty feet, and the *nopal* whose branches bear an edible fruit.

On account of the narrowness of that portion of the continent, which does not admit of the collection of a great mass of water, Mexico contains very few navigable streams, the principal ones being the Goatzacoalcos, Tabasco and Panuco rivers. There are sand-bars at the mouths of some of the rivers, on which the depth of water at low tide is not more than three or four feet. Several streams might be made navigable at comparatively small expense. This fact applies especially to the Rio de Santiago, the longest river in the Republic, according to Humboldt, who states that it is as long as the Elbe or Rhone, and that the grain from the States of Guanajuato and Jalisco could be thus transported to the western coast.

The following list gives the names and lengths of the principal rivers in Mexico:

	Miles.		Miles.
Rio de Santiago	542	Rio Panuco	286
Rio de las Balzas	418	Rio de Sinaloa	277
Rio Yaqui	338	Rio de Ures	208
Rio Conchos	338	Rio de Culiacan	156
Rio de Tabasco	344	Rio de Goatzacoalcos	112
Rio Usumasinta	341		

Several of these streams descend rapidly from the Sierra to tide-water in a comparatively short distance.

There are many lakes on the Mexican plateau, most of which are little more than extensive lagoons. They are merely the remains of large basins of water which formerly existed on the high plains of the cordillera. The majority of these lakes have no outlet, and are accordingly filled with salt water. Owing to rapid evaporation, their surface is continually diminishing. The Lagoon of Terminos, on the coast of the Gulf of Campeche, is the largest in Mexico, but it is an arm of the sea, rather than a lake. Lake Chapala in Jalisco is the largest inland body of fresh water. Lakes Patzcuaro and Cuitzeo in Michoacan are next in importance.

There are many islands that belong to Mexico off the northwest coast. Several islands are also found in the Bay of Campeche and off the eastern coast of Yucatan.

Formerly one of the most interesting features in the physical geography of the country was the so-called *floating islands* of Lake Texcoco in the Valley of Mexico. They do not exist at the present day. They were formed of small masses of earth, covered with herbs, and held together by matted roots, and were detached from the shore of the lagoon by the waves during stormy weather. These fertile islets are known to have been in use as far back as the end of the fourteenth century. They were afterward artificially constructed by the Aztecs by making rafts of reeds, rushes, roots and brushwood, and covering these with black mold naturally impregnated with muriate of soda, but gradually purified from the salt and rendered fertile by washing it with the water of the lake.

No country on the globe has a greater variety of climate than Mexico. The mean annual temperature of the three zones is as follows: For the *tierra caliente*, 77°; for the *tierra templada*, from 68° to 70°; and in the *tierra fria*, 62° Fahr. Sudden changes of temperature are rare in the latter and in the *tierra templada*, but they are more frequent in the former zone. In Vera Cruz, the mercury often stands at 90° in the warm season, but if the wind suddenly changes to the northward, it will sink to 65° Fahr. in a few hours.

The rainy season varies slightly in different parts of Mexico, but always occurs in the summer months. In Yucatan, Campeche, Tabasco and Chiapas, it lasts from May to October, while the season begins a little later and ends a little earlier in the States of Oaxaca and Guerrero. In the latitude of the national capital, the rains fall between June 1st and October 1st, with occasional showers during the winter, especially in February, when the weather is very changeable. The Mexicans have a proverb which runs thus :

"Febrero loco,
Porque de todo,
Tiene un poco,"

which, being interpreted, means, February is a fool because it has a little of everything, *i. e.*, all kinds of weather. The average annual rainfall at the City of Mexico amounts to fifty-nine inches, and that at Vera Cruz is equal to sixty-six inches. In the northern part of Mexico, the rainy season occurs in the months of July, August, September, and half of October.

Snow falls in winter at an elevation of about 8,500 feet. According to Humboldt, the line of perpetual snow in Mexico is 15,091 feet above the level of the sea.*

The atmosphere on the Mexican plateau is very dry. This aridity proceeds from two causes : 1. The evaporation that occurs on great plains, which is increased by the height of the table-land ; and, 2. The country is not sufficiently elevated for a considerable number of the mountains to penetrate the region of perpetual snow. Strangers are liable to suffer from thirst and chapped lips on arriving in the Valley of Mexico, owing to the dryness of the climate. The nights are cold throughout the year on the great table-land north of the eighteenth parallel of latitude. In general, the temperature will sink as low as 45° Fahr., and the thermometer will fall to the freezing point occasionally on the higher plains. The coldest part of the night is just before daybreak. In the vicinity of the snow-clad mountains the sky is usually free from clouds in the early morning, but toward nine o'clock they rise gradually, and often cover the higher peaks for the remainder of the day. In the *tierra caliente*, and in the greater part of the *tierra templada*, a clear sky frequently prevails throughout the year, except for a few hours of the day during the rainy season. Strong winds are common on the table-land, and the dust often rises in clouds on the sandy plains.

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* Under the equator the snow-line is estimated at 15,750 feet.

New Spain was formerly divided into ten districts, viz.: The kingdoms of Mexico, New Galicia and Leon; the colony of New Santander, and the provinces of Texas, Coahuila, New Biscay, Sonora, New Mexico and the two Californias.

The country was subsequently partitioned into twelve intendancies and three provinces, as follows :

1. The province of New Mexico.
2. The intendancy of New Biscay, or Durango.
3. The province of New California.
4. The province of Old California.
5. The intendancy of Sonora.
6. The intendancy of San Luis Potosi.*
7. The intendancy of Zacatecas.
8. The intendancy of Guadalajara.
9. The intendancy of Guanajuato.
10. The intendancy of Valladolid.

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* The largest as regards area.

11. The intendancy of Mexico.*
12. The intendancy of Puebla.
13. The intendancy of Vera Cruz.
14. The intendancy of Oaxaca.
15. The intendancy of Merida, or Yucatan.

The Republic of Mexico is now divided into twenty-seven States, one Territory and one Federal District. The several States are subdivided into 48 departments, 170 districts, 48 cantons, 110 counties, 1,411 municipalities, 146 cities, 378 towns, 4,886 villages, 872 hamlets, 6 missions, 5,869 haciendas, and 14,705 ranches.

The following is a list of the Mexican States, classified according to superficial area:

	Square kilometres.		Square kilometres.
Chihuahua	227,716	Michoacan de Ocampo	55,693
Sonora	209,694	Chiapas	43,930
Lower California (Territory).	152,847	Nuevo Leon	38,156
Coahuila de Zaragoza	152,517	Tabasco	32,935
Jalisco	114,896	Puebla	31,120
Durango	110,463	Mexico	25,972
Yucatan	84,585	Hidalgo	21,693
Tamaulipas	75,191	Guanajuato	20,276
San Luis Potosi	71,210	Querétaro de Orteaga	8,300
Vera Cruz-Llave	71,116	Colima	7,136
Oaxaca	70,838	Aguascalientes	5,776
Sinaloa	69,211	Morelos	4,536
Zacatecas	68,596	Tlaxcala	3,898
Guerrero	68,568	Federal District	231
Campeche	67,539		
Total			1,958,912

Agriculture in the Aztec Empire was the most important of all the industrial arts. In the natural openings of the primeval forest, or in a fertile strip of interval, the

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* The largest in population.

Aztecs planted beans and Indian corn. Excepting the nobility and soldiery, the cultivation of the soil gave employment to the greater part of the population. The more important branches of husbandry were, the culture of the banana, which was easily grown and gave exuberant returns ; the production of *chocolatl* from the cocoa-palm ; the cultivation of the vanilla, which, however, was confined to a small strip of the sea-coast ; and the planting of maize and the *maguey*. Prescott calls the latter "a miracle of nature," on account of the large number of articles that are made from it. The Mexicans pressed the stalks of Indian corn to obtain the sap for the production of sugar. There is no evidence that the tillage of the country was materially improved for many years after the Spanish Conquest.

Almost a century elapsed before the Spaniards introduced new plants, like wheat and the other cereals. Notwithstanding the fact that Mexico has been governed by Europeans during nearly four centuries, and considering the existence of an easily worked and fertile soil, agriculture is still in its infancy in the major part of the Republic. This is due, in great measure, to the persistency of the peons in adhering to the rude implements of their forefathers. They plow to a depth of but three or at most four inches, with a crooked wooden stick, shod with iron, which is attached to the horns of the oxen. The hoe serves as their scythe, sickle and reaper. .The *machete*, or cutlass, is used in place of the axe. Living in the most primitive manner as the peons do, but little ground is required for cultivation. They raise just sufficient crops to meet their absolute needs.

Since the Spanish Conquest the mines have been developed at the expense of the vegetable resources. The ambition of Cortez and his followers was to increase the production of the precious metals. Accordingly, agriculture did not receive any considerable share of attention from the invaders. Doubtless Mexico would be a far richer country to-day had the Spaniards devoted themselves to the cultivation of the soil with as much energy as they displayed in their quest for gold. So brilliant has been Mexico's record in the production of gold and silver, that the world at large seems to have underestimated, if not wholly overlooked, her agricultural capacity.

The crops in Mexico are dependent partly upon rainfall and partly upon irrigation. North of the nineteenth parallel, irrigation is necessary. Referring to this important subject, Humboldt has remarked in his *Political Essay on New Spain*, Vol. II., page 455 : "Were the soil of Mexico watered by more frequent rains, it would be one of the most fertile countries cultivated by man in either hemisphere." The prosperity of the Republic depends upon the proportion of dry and wet season. In the Southern States the rains are generally limited to one continuous season, which varies from five to seven months in the year. As in other tropical latitudes, a deluging rain oftentimes does more harm than good to the growing crops.

The farmer, of course, takes advantage of the rainy season, and in the Northern and Central States he sows in May and reaps in October. Two crops of wheat and Indian corn are grown annually in various sections of the *tierra caliente* and *tierra templada* and even in portions of the *tierra fria*. The second crop is, however, sometimes destroyed by a premature frost. In the States of Vera Cruz, Oaxaca, Guerrero, Tabasco, Mexico, Jalisco and Sinaloa, *three* crops of maize are cultivated in a single year!

They are called respectively the *riego*, *temporal* and *tonalmile.*

As irrigation is necessary for *more* than one-half of the surface of the country, let me now consider this subject. In the Aztec Empire *acequias*, or irrigating ditches, were used. The Spaniards were agreeably surprised to find a system similar to that which the Moors had established in the Iberian Peninsula. The plan of watering the soil by artificial channels, however, is at present limited to a comparatively small portion of the arable land in the country. In order to increase the annual yield of grain and vegetables, the Mexicans will perhaps find it necessary to adopt the system of tanks which has been in use so long in Hindostan.

Having had occasion to examine the system of tanks and ditches for irrigation during my travels both in British India and Spain, I venture to digress for a moment and describe them. British India comprises about the same superficial area as Mexico. In the north, great rivers like the Indus and Ganges are tapped, and a portion of the main stream is diverted from its course by a series of canals. The water is thus distributed over the country for the purpose of irrigation.

In Southern India and in the Carnatic tanks are built by making an artificial wall across a ravine. In this manner crops are grown which support a population of about a hundred millions, or ten times the present population of Mexico. The failure of the crops, which causes the terrible famines of Hindostan, is frequently owing to a long season of drought or to defective irrigation. When, at the end of the eighth century of our era, the Moors conquered Spain, they built a system of tanks and ditches, second in extent and ingenuity to none on the face of the globe.

After seven centuries of occupation the crescent was expelled from the Peninsula in the reign of Ferdinand and Isabella, and the cross was planted in the shadow of the Saracenic arch. Thus did the Spaniards learn the importance of irrigation from their Moslem enemies, and accordingly practiced it in their transatlantic kingdom, which they called New Spain.

Now to return to Mexico, let me say that not more than ten millions of people inhabit the country. Unlike India, Mexico has no huge rivers affording a powerful head of water. In the *tierra templada*, where a few waterfalls may be found, the streams might be diverted from their course and employed for irrigation at very slight expense. Corporations may in future be organized for the purpose of irrigation, and the ravines or *barrancas* of the *sierra* will be converted into reservoirs for the storage of a supply of water to be used for seasons of drought.

By the means thus indicated, the soil of Mexico might be made to yield a hundred-fold more grain than is now produced, and the Republic would be eventually enabled to compete with the States of California and Oregon in exporting the cereals to Europe.* Grain is now sent from California to New Orleans, La., *via* the Southern Pacific Railroad. The cereals of Northern Mexico might be transported to the seaboard by the same route. This subject is perhaps worthy of the attention of foreign capitalists.

As regards the amount of cereals cultivated within a given area in Mexico it may be remarked, that the proportion of grain to seed varies from forty to one to four hundred to one. An average yield would be about one hundred and fifty to one. In very fertile land one *fanega* (about three bushels) of seed will produce four hundred *fanegas* of maize. Humboldt has stated that the finest soil on the plateau is to be found in the rich plains lying between the cities of San Juan del Rio and Leon.

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* Notwithstanding her immense mineral resources, California has since 1876 yielded more in agricultural products than from her mines. This State resembles Mexico in soil and in outline. According to Señor M. Romero, more wheat can be raised in Sonora alone than in all California.

Next to the cereals, the great staple products of Mexico are coffee, sugar, tobacco, cocoa, and cotton. All except the last-named are exported.

Among these commodities coffee is the most important to Americans. According to the Hon. J. W. Foster, the late Minister of the United States to Mexico, enough coffee can be grown in that Republic for the entire consumption of this country, amounting in the year 1882 to 455,000,000 pounds. This plant grows best in the *tierra templada* and in the shade of the forest. The State of Vera Cruz yields the largest quantity. Colima ranks next, and produces the finest variety of the article. It rivals the choicest Mocha berry. There is a great demand by epicures in foreign countries for Mexican coffee; and doubtless the annual production will soon be greatly augmented.

Sugar-cane grows in the *tierra caliente* and *tierra templada* up to an elevation of 5,000 feet. In the latter, eighteen months are required for the crop to mature, while in the former the time varies from nine to twelve months. The sugar-cane of Mexico is of three kinds—viz., those of Castile, Havana, and Otaite. In the year 1803 about 14,000,000 pounds of sugar were exported annually. The amount did not exceed 500,000 pounds in the year 1881.

Tobacco is indigenous to Mexico. Indeed, it derives its name from the town of Tobaco in Yucatan. The culture of tobacco was formerly restricted by law to the vicinity of

Orizaba. At present it grows chiefly in the States of Vera Cruz, Tabasco, Campeche, Yucatan, Oaxaca, Sinaloa, Chiapas, and Jalisco.

Cocoa is found in the States of Tabasco, Chiapas, Oaxaca, Guerrero and Colima. The first-named State produces the largest amount, the culture of cocoa being the principal branch of its agricultural industry. Chiapas ranks second, and but little of this article grows in the remainder of the Republic.

Cotton is cultivated in about half the number of the States. Vera Cruz produces the largest quantities, and Durango ranks next. The finest cotton comes from the Pacific coast States and from Vera Cruz. It is also grown extensively in the vicinity of the lagoon of Tlahualila (which is familiarly called the "laguna country"), and in Southern Chihuahua. According to Señor Busto, an acre of land in the State of Vera Cruz will yield about 2,000 pounds of cotton as an average.* It thrives up to an elevation of five thousand feet. In the year 1803 the annual exportation of cotton amounted to 700,000 pounds. At present it is not exported, nor is it cultivated in sufficient quantities for home consumption.

Vanilla and sarsaparilla are grown in the States of Vera Cruz, Tamaulipas, and Tabasco. According to Humboldt, Europe received its entire supply of the former commodity from Mexico previous to the year 1812.

With the improved processes of tillage, including the use of modern implements, extensive tanks, and irrigating ditches, all of which are likely to be introduced at an early day, the staple products of Mexico will of course be increased many fold.

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* In the southern part of the United States, 1,000 pounds of cotton to the acre is a fair average.

The culture of sugar, cocoa, and tobacco is, and will doubtless continue to be, more profitable than that of the cereals. The cultivation of the tropical and semi-tropical fruits will also be carried on far more extensively than at present throughout the *tierra caliente*, and in parts of the *tierra templada.*

The crooked wooden stick will be replaced by the steel-beam and mould-board, or sulky plow; the *machete* by the axe and brush-scythe; the bare threshing ground, where sheep and cattle trample out the grain, by the steam-thresher, and the hooked-sickle by the header and self-binder.

Agricultural implements are admitted free of duty. American reapers, mowers, plows, etc., have lately been introduced on the farms of the northern and central part of the table-land. Time will, however, be required to induce the peons to abandon their rude ancestral tools that simply scratch the ground. Labor is abundant at three *reales* (37½ cents) a day. It is hardly necessary to remark, that the land will be best developed by the immigration of skilled farmers from Europe and the United States.

The mineral resources next demand attention.

The cordillera, from Chihuahua on the north, to the Isthmus of Tehuantepec on the south, contains almost inexhaustible deposits of gold, silver, iron, copper and lead; while zinc, mercury, tin, platinum, and coal occur in a few localities. Before the Spanish Conquest the mines of gold, silver, copper and tin were worked by the Aztecs. As the reduction of these metals from their ores was simple, it should not be supposed that the ancient Mexicans possessed a thorough knowledge of the art of metallurgy.

Gold was used largely for ornament and to a limited extent as money in the Aztec Empire; but the accounts given by the chroniclers of the time of the fabulous amount of this metal used by the Mexicans have been greatly exaggerated. It is, however, true that Cortez seized a large quantity of gold at the capitulation of Tenochtitlan, the ancient capital.

Few mines were in operation at the time of the Spanish invasion, and for twenty-five years after that period. In the year 1548, the silver deposits of Zacatecas were discovered, and twelve years later the great vein of Guanajuato began to be developed. For nearly two centuries the supply of silver in Mexico was derived chiefly from the mines of these two districts. About the year 1728, the mines of Zacatecas yielded $1,800,000 annually, which was then estimated at one-fifth of the entire silver coinage of New Spain.

In the year 1803 the average annual production of the precious metals amounted to $20,000,000 of silver, and only $5,600 of gold. During the War of Independence the quantity of metal extracted from the gold and silver ores was greatly diminished. Humboldt states in his great work on New Spain that two-thirds of the silver supply of the whole world was annually shipped from the port of Vera Cruz, between the years 1800 and 1812. Some silver was also sent abroad from Acapulco. At present the yearly exportation of silver to Europe is valued at about $18,000,000.

Up to the year 1875, it is said that the mines of Mexico had yielded fifty-eight per cent. of the stock of silver thus far produced in the entire world. The value of this amount is equal to $3,700,000,000.

We should remember, however, that some of these mines are now on American soil, *e. g.*, those of California, Nevada, New Mexico, and Arizona. The yield of silver for 1882 can be roughly estimated at $28,000,000, while that of gold amounts to about $1,000,000.*

The supply of silver in Mexico is now derived chiefly from the mines of Guanajuato, Zacatecas, Sombrerete, Catorce, Pachuca, Bolaños and Batopilas. Gold generally occurs in small quantities with the silver ores. But most of it is lost in the process of reduction.

Perhaps the two most remarkable argentiferous veins of North America, excepting the famous Comstock Lode of Nevada, are the *veta madre* of Guanajuato and the *veta grande* of Zacatecas. These veins have been worked for about three hundred years. The region adjoining these mining towns is an elevated desert, similar to the environs of Virginia City in Nevada.

Although silver-bearing veins at present constitute the most valuable part of the mineral wealth of Mexico, we should not forget the numerous deposits of iron, copper, lead, tin, coal and petroleum, which are found in the country.

Next to argentiferous deposits in importance are the immense beds of iron, which consist principally of the oxides called magnetite and hematite. The well-known *Cerro del Mercado*, in the State of Durango, has been computed to contain sixty million cubic yards of iron ore, having a specific weight of five billion quintals. This metallic mass is valued at $10,000,000,000. An analysis of this ore by Mr. M. H. Boye, of Philadelphia, Pennsylvania, gave 66 per cent. of pure metal. There are other vast hills of iron in Sonora, near Coalcoman, in Michoacan, and in the central part of the State of Oaxaca.

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* The production of the mines of the United States for the fiscal year ended June 30, 1883, was $47,000,000 of silver and $32,000,000 of gold, given in round numbers.

Lead ores, usually in the form of galena and oftentimes argentiferous, are abundant throughout the country. Copper, either native or as oxide, carbonate or sulphide, is mined at various localities in Chihuahua, Oaxaca and Lower California, at the towns of Mazapil and Jalapa, and near the volcano of *Jorullo.*

The oxide of tin is found in veins and alluvial beds at Durango. Mercury, which is usually in the form of cinnabar, occurs in several portions of the Republic.

There are beds of coal in various parts of Mexico. The most important deposits are found in the States of Oaxaca, Hidalgo, Puebla, and Sonora, and on the Rio Grande, near the town of Piedras Negras. A rich quality of anthracite coal is mined on the Yaqui River in Sonora. It contains ninety per cent. of carbon. I may say that few varieties of coal in Pennsylvania are equal to that of Sonora in richness. Lignite, or brown coal, is abundant throughout the Republic. It is worthy of remark, that the discovery of an extensive mine of coal near the City of Mexico, would be of far more value at present than one of gold.

As regards the cost and methods of mining in Mexico, it may be said, that the art has not yet attained the high degree of perfection known in Europe and the United States. Humboldt stated, in the year 1803, that subterranean geometry was mostly unknown, and that the means of communication between contiguous mines were badly arranged. Millions have been expended in developing the mineral wealth of Guanajuato and Zacatecas. It is said that the Count de Valenciana dug three pits in a single mine near the former city at the cost of $1,700,000.

Owing to the low price of labor and the very economical methods of the natives, more can be accomplished for a given amount of money at present, by working the metallic mines on the old Mexican plan, than by the modern and improved system. There are few shafts in the Mexican mines that have been sunk to a greater depth than 1,000 feet. *Malacates*, or large horse-whims, are substituted for steam hoisting works. Instead of using steam pumps, the water which accumulates at the bottom of the pits is raised in large skins attached to ropes, or carried up the ladders in leathern bags by native porters.

I have seen peons in the mines stooping like beasts of burden while carrying pieces of ore weighing as much as 200 pounds on their backs, from the "heading" of a level to the main shaft. The levels are not usually of sufficient dimensions to enable a man to walk erectly in them. The shafts of the mines are generally used only for hoisting the ores, which are placed in huge baskets.

The peons descend into the pits by means of massive stone steps that have been used for ages, as in Guanajuato, or by a series of short ladders as in Zacatecas and other mines on the northern plateau. On leaving the silver mines each peon is searched, as fragments of the precious metals are oftentimes concealed under his arms and in his hair or clothing.

For the last three centuries the *patio*, or cold amalgamation process of reducing silver ores, has been employed in Mexico. This method consists in pulverizing the ore in *arrastres* and mixing it with mercury, salt and sulphate of copper, after which the silver is separated by means of sublimation. This system can only be adopted, however, where water is to be had, *i. e.*, in the vicinity of a stream.

Owing to the high price of fuel, the *patio* process is more economical than the modern methods of reducing the silver ores.

The mines in Mexico belong to individuals. If abandoned, however, they revert to the State. In order to hold a mine the owner is required to work it during four consecutive months of the year. Should the proprietor neglect to conform to the law, the mine is "denounced," and is soon advertised for sale.

With the exception of the ores of silver and iron, no mineral found in the country will be of more importance in future than petroleum. There are extensive oil wells near the east and west coasts of the Republic, as well as on the table-land. It is the opinion of experts that these wells are of equal richness to those in Pennsylvania.

There is abundant petroleum in the Republic, not only for home consumption, but also for exportation to Europe. Instead of importing in future one and a half million gallons annually from the United States, Mexico will soon cease to consume a single gallon of the American product. It is highly probable that New Orleans, Galveston, and other cities on the Gulf of Mexico, will, at no distant day, be supplied with oil from the State of Vera Cruz. At the time of my visit several oil-refineries were in course of erection near Tuxpan in Northern Vera Cruz. On account of the scarcity of bituminous coal, petroleum must needs be employed in the illumination of the houses of Mexico.

The electric light has been adopted on the main streets of several of the larger cities, but of course it cannot be recommended for universal use.

Many guano islands are found in the portions of the Gulf of Mexico bordering on Yucatan. They are numerous in the northern and eastern parts of the Bay of Campeche. A concession to work these valuable deposits of fertilizers for the term of fifteen years has been granted to a company known as the Transatlantic Association, in which the controlling interest is jointly held by American and British capitalists.

Among the most important and valuable of the industries of Mexico in the near future will be the raising of domestic animals, including horses, mules, horned cattle, sheep and goats. As herdsmen the Mexicans are not surpassed by any other people. While a large portion of the great plateau is not susceptible of profitable tillage, this region is admirably adapted to grazing.

Owing to the mildness of the winters, the animals do not require to be housed nor fed during any season of the year. These conditions apply to the Northern States, comprising an area of not less than 200,000 square miles. About two-thirds of this immense tract affords excellent pasturage. The remainder consists chiefly of mountain and desert, which, however, are interspersed here and there with small sections of farming land.

A few Americans and Englishmen have recently established extensive ranches in this part of the country, where land is to be had at very low prices, and in tracts of almost unlimited extent. Artificial tanks or ponds are used for supplying the live-stock with water. The Mexican cattle are descended from the fine stock brought from Spain at an early period—perhaps soon after the conquest of the country. They are hardy, prolific, and are highly esteemed by the American drovers.

According to the Hon. W. P. Sutton, the American Consul-General at Matamoros, the number of cattle in Northern Mexico may be roughly estimated at six and a half millions, as follows :

Goats	2,500,000
Neat cattle	1,500,000
Horses	1,000,000
Sheep	1,000,000
Mules	500,000
Total	6,500,000

Intimately connected with the growth of Mexico is the system of railroads which I will now describe.

The great desideratum in Mexico has always been cheap and rapid transportation. Excepting a few wagon roads connecting the chief cities, trade between the seaboard and the interior has heretofore been carried on by means of pack animals.

Owing to the very small number of navigable streams, and the vast wealth of her mineral and vegetable products, Mexico offers exceptional facilities for the successful operation of railways.

The Liberal Party in Mexico, which have recently come into power, believe that the development of the immense resources of the country can only be accomplished by the construction of railroads. Accordingly, having but little public land to grant for this purpose, the Government pays subsidies in order to encourage both natives and foreigners to build railways. These subventions, as they are called, vary from $10,500 to $15,300 per mile, and are supposed to amount in the aggregate to about one-third of the cost of the roads. They now reach a total of about $7,000,000 annually.

The plan of building railways in Mexico has been to work from each end toward a central point. This method proved very expensive to the Mexican Railway, but it is nevertheless found expedient to adopt it in the construction of the American trunk-lines. The latter rarely pass through the cities and towns along the route, as the inhabitants prefer to keep the railroad track at a considerable distance; for example at Monterey, the station is one and a half miles from the city.

With the exception of the Mexican National Railway and the Morelos Railway (the latter being owned by Mexicans), the American standard gauge of four feet eight and a half inches has been adopted on the principal lines of the country. These two roads are constructed of the narrow gauge (*via angosta*), which is thought to be well adapted to the wants of the region traversed by them.

With the railroads, constructed and controlled by American enterprise and capital, will come two all-important benefits: first, improved processes in agriculture, mining, manufactures, and every other branch of the industrial arts; second, cheap transportation which, by leaving to the tiller of the soil and to the toiler in the mines an increased share of the fruits of his industry, cannot fail to elevate his social, intellectual, moral, and political condition.

The first line of railroad—that of the Mexican Railway Company, connecting the City of Vera Cruz with the national capital, a distance of 263 miles—was begun in 1837. On September 16, 1869, the branch of this road from Mexico to Puebla, a distance of 115¾ miles, was opened with great pomp and ceremony. Trains commenced running on the division between Orizaba and Vera Cruz on September 5, 1872, and the entire route was completed on January 17, 1873. The cost of this road was about thirty million dollars.

The Mexican Central Railway extends from the City of Mexico in a northerly direction *via* Queretaro, Leon, Aguascalientes, Zacatecas, Villa Lerdo, Jimenez, and Chihuahua, to Paso del Norte, on the Rio Grande. This road connects with the Atchison, Topeka and Santa Fe Railroad. Short branch lines will be built to the mining cities of Guanajuato and Durango. The distance from the City of Mexico to the Rio Grande is about 1,200 miles. At present there is an unfinished space of about 100 miles on the main line between Villa Lerdo and Zacatecas. It is believed that the entire route will be completed on April 1, 1884. Another line is in course of construction by the Mexican Central Railway Company from Tampico on the Gulf of Mexico, *via* San Luis Potosi, Aguascalientes and Guadalajara, to San Blas on the Pacific Ocean. This road has been built to a point about ninety miles westward of Tampico.

The Mexican National Railway has two divisions. The main line runs *via* Toluca to Acambaro. At this point the western division extends to Morelia, and thence to Manzanillo on the Pacific, *via* Zamora and the northern side of Lake Chapala. The distance from the capital to Manzanillo is 615 miles. From Acambaro the northern division is continued over the table-land *via* San Luis Potosi, Saltillo, and Monterey to Laredo on the Rio Grande. The last-named town is 820 miles from the City of Mexico. Connection with the port of Corpus Christi, on the Gulf of Mexico, is made by the Texas Mexican Railway (163 miles in length), which is controlled by the Mexican National Railway Company. This company has also a concession for building a road from Zacatecas, *via* Ojo Caliente, to San Luis Potosi, and from the former city to Aguascalientes. The northern division of this railway will be completed during 1885, there being an unfinished section at present of about 300 miles. But a small portion of the western branch has been constructed. Morelia is the temporary eastern terminus, and the track has been laid from Manzanillo to Armeria, a distance of thirty miles.

The Morelos Railway is the only important line which is owned and operated by Mexicans. It extends from the national capital southward *via* Amecameca to Cuautla, a distance of about eighty miles. The latter town is the present terminus. From this point the railway will be prolonged to the port of Acapulco *via* Cuernavaca and Chilpancingo. Acapulco, which is the finest harbor on the Pacific coast, is about 300 miles from the City of Mexico. A branch leaves the main line at Los Reyes, about eleven miles from the capital, and runs easterly, *via* Texcoco, to Irolo, which is the present terminus. This division will be continued *via* Perote and Jalapa to Vera Cruz.

The Mexican Southern Railroad, of which General U. S. Grant is president, connects at Laredo with the so-called Southwestern Railway System (comprising about 7,000 miles of track) by means of the International and Great Northern Railroad. Beginning at Laredo, this line will run almost due south *via* Mier, Victoria, and Tulancingo, to the City of Mexico, a distance of about 600 miles. The company has the option of constructing branch roads to San Luis Potosi, and to the Gulf ports of Tampico, Tuxpan, and Vera Cruz. Leaving the national capital, the Mexican Southern Railroad will run parallel with the Mexican Railway for about eighty miles, when it trends to the southward toward Oaxaca *via* Puebla, Tehuacan, and Arenal. At the last station a branch line is in process of construction to Anton Lizardo, on the Gulf of Mexico, 142 miles distant. This division will be continued to Vera Cruz, a distance of twenty-three miles. From Oaxaca the main line will extend *via* Ejutla, Miahuatlan, and Tehuantepec, to Tonalá. The road bifurcates at the last place, one branch leading northeasterly to San Cristobal, the other going to Tapachula, and thence it will probably be prolonged to the City of Guatemala. Not more than five or six miles of track of the Mexican Southern line have been laid thus far.

The New York, Texas, and Mexican Railroad, which is better known as Count Telfener's * road, begins at Rosenburg Junction in Texas, and will run across the Rio Grande at Matamoros, and thence southward *via* Santander, Tampico, and Tuxpan, to the City of Mexico. Branch lines will be extended eastward to Soto la Marina, and westward to Victoria in the State of Tamaulipas. No portion of this road has yet been completed.

The Mexican International Railroad extends from Piedras Negras on the Rio Grande southward *via* Sabinas to Monclova, and thence across the so-called "laguna country," toward the Mexican Central Railway. A junction will be made with the latter line in the vicinity of Lerdo. This road is in operation between Piedras Negras and Monclova. An iron bridge crosses the Rio Grande at the former town, where connection is made with the Galveston, Harrisburg and San Antonio Railroad.

The American and Mexican Pacific Railway begins at Topolobampo Bay and, traversing the States of Sinaloa, Chihuahua, and Coahuila, ends at Piedras Negras. The company has the right to extend branch lines southward to Mazatlan and northward to Guaymas. The work of construction has not yet been commenced.

The Sonora Railway connects with the Southern Pacific Railroad at Benson in Arizona. From this point it runs southward to Nogales on the Mexican frontier, and thence *via* Magdalena and Hermosillo to the port of Guaymas—a total distance of 353 miles. This line was completed on November 25, 1882.

It may be remarked, that with the exception of the Morelos Railway, all of the lines thus far described extend from the United States toward the heart of Mexico, while one road (the Mexican Southern) is projected beyond the capital into

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* Count Telfener is an Italian capitalist.

Guatemala. A few other railways are in process of construction in Southern Mexico and Yucatan. Among them may be mentioned the following roads:

The Tehuantepec Railroad, which commences at the mouth of the Goatzacoalcos river, and will run almost due south to Salina Cruz on the Pacific. The line will be about 190 miles long, and its completion will bring about formidable competition with the Panama Railway, especially as regards passenger traffic. Beginning at the northern terminus about thirty miles of track have been built. It may be said that the commercial advantages of a means of communication across the Isthmus of Tehuantepec either by land or water can hardly be overestimated. While the commerce between Europe and the Pacific Ocean will be carried on *via* the Isthmus of Panama for many years, the greater part of the trade between the Atlantic and Pacific coasts of the United States must needs be conducted across the Isthmus of Tehuantepec as soon as the railway is finished.

Several railroads are in course of construction in the State of Yucatan. A line has recently been built from the port of Progreso to Merida, the capital of the State, twenty-two miles distant. Three railways are projected from Merida; toward Valladolid on the southeast, to Peto on the south, and toward Campeche *via* Calkini, on the southwest. About 100 miles of track have been laid thus far on these three lines.

Charters have been granted by the National Government for the construction of various other lines of railway, but the date of their completion is so remote that I will not mention them here.

On January 1st, 1884, about 3,000 miles of railroad were in operation in the Mexican Republic. The concessions made to American capitalists alone amount in round numbers to 13,000 miles.